

What is claimed is:

1. A medical imaging system for conducting an image-guided medical procedure on a subject, the system comprising:

a medical imaging apparatus for obtaining volumetric images of the subject;
means for planning an interventional procedure on a subject using the volumetric

images;

a mechanical arm assembly disposed in proximity to the medical imaging apparatus, the mechanical arm assembly comprising a base support, a distal end, a plurality of arm segments, and a plurality of joints between the arm segments for carrying out the interventional procedure; and

an end-effector disposed at the distal end of the mechanical arm assembly, the end-effector comprising gripping means for selectively gripping and releasing a surgical instrument during the interventional procedure.

2. A medical imaging system according to claim 1 wherein the end-effector further comprises:

a first finger portion having a first gripping surface;

a second finger portion having a second gripping surface, the first and second gripping surfaces being opposed to one another for applying a gripping force to the surgical instrument;

a first surgical instrument guide disposed on the first finger portion and extending towards the second finger portion; and

a second surgical instrument guide disposed on the second finger portion and extending towards the first finger portion.

3. A medical imaging system according to claim 2 further comprising incremental movement means for incrementally inserting the surgical instrument along a trajectory into the subject.

4. A medical imaging system according to claim 3 wherein the trajectory is linear.

- 5 6. A medical imaging system according to claim 2 wherein the gripping force has a magnitude that allows the surgical instrument to be manually inserted into the subject.
- 6 7. A medical imaging system according to claim 2 wherein the first surgical
5 instrument guide applies a first force to the surgical instrument in a direction perpendicular to the first gripping surface and the second surgical instrument guide applies a second force to the surgical instrument in a direction perpendicular to the second gripping surface.
- 7 8. A medical imaging system according to claim 7 wherein the first force and the
10 second force are substantially zero.
- 8 9. A method of conducting an image-guided medical procedure on a subject, the method comprising:
generating at least one volumetric image of the subject;
15 planning an interventional procedure on the subject using the at least one volumetric image;
gripping a surgical instrument with an end-effector, the end-effector being disposed at a distal end of a mechanical arm assembly;
moving the surgical instrument into the subject along a trajectory in accordance
20 with the planned interventional procedure using the mechanical arm assembly; and releasing the surgical instrument.
- 9 10. A method of conducting an image-guided medical procedure according to claim 9 further comprising the steps of:
25 moving the end-effector away from the subject;
regripping the surgical instrument; and
moving the surgical instrument further along the trajectory.
- (D 11. A method of conducting an image-guided medical procedure according to claim 10
30 wherein the trajectory is linear.

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- 11 12. A method of conducting an image-guided medical procedure according to claim 9
wherein the step of gripping comprises the steps of:
applying a gripping force to the surgical instrument using a first gripping surface
disposed on a first finger portion of the end-effector and a second gripping surface
5 disposed on a second finger portion of the end-effector; and
stabilizing the surgical instrument using a first instrument guide disposed on the
first finger portion and a second instrument guide disposed on the second finger portion.
- 12 13. A method of conducting an image-guided medical procedure according to claim 12
10 wherein the step of stabilizing the surgical instrument has a stabilizing force in a direction
perpendicular to the first and second gripping surfaces associated therewith.
- 13 14. A method of conducting an image-guided medical procedure according to claim 13
wherein the stabilizing force is substantially zero.
- 15 15. A medical imaging system comprising:
14 imaging means for generating at least one volumetric image of a subject;
planning means for planning an interventional procedure on the subject;
a mechanical arm assembly disposed in proximity to the imaging means, the
20 mechanical arm assembly comprising a base support, a plurality of arm segments, a
plurality of joints, and a distal end;
an end-effector disposed at the distal end of the mechanical arm assembly, the end-
effector comprising:
a first finger portion having a first gripping surface;
25 a second finger portion having a second gripping surface, the first and
second gripping surfaces being opposed to one another for applying a gripping force to a
surgical instrument;
a first surgical instrument guide disposed on the first finger portion and
extending perpendicularly to the first gripping surface; and
30 a second surgical instrument guide disposed on the second finger portion
and extending perpendicularly to the second gripping surface.

16. A medical imaging system according to claim 15 further comprising a mechanical arm controller for controlling the mechanical arm such that the surgical instrument moves along a path in accordance with the planned interventional procedure.
17. A medical imaging system according to claim 16 wherein the path comprises a linear trajectory into the subject.
18. A medical imaging system according to claim 17 wherein the movement of the surgical instrument along the path includes relative movement between the surgical instrument and the end-effector along the linear trajectory.
19. A medical imaging system according to claim 18 further comprising position tracking means for tracking a position of the surgical instrument.
20. A medical imaging system according to claim 15 wherein the first surgical instrument guide comprises a first and second prong, the first and second prongs extending past the first gripping surface and the second surgical instrument guide comprises a third and fourth prong, the third and fourth prongs extending past the second gripping surface.

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